ORNITHOLOGY.—*The starling's family life and behaviors.*[1] H. A. Allard, Washington, D. C.

In many parts of the United States and Canada the introduced starling (*Sturnus vulgaris*) has become one of our most familiar and abundant birds. While it is generally conceded that this bird is highly versatile and adaptive in its behavior, there is much to learn considering the daily activities of its summer family life, and the various manifestations of its gregarious life throughout the wintertime.

In February, 1929, the writer erected at the end of his barn an observation box, so constructed with a glass top in a darkened attic that one could at all times observe intimately every behavior of the parent birds and the young within, since the eyes of the observer were brought within 7–8 inches of the nest. This box was furnished with an entrance hole slightly over $1\frac{3}{4}$ inches in diameter, to admit the starlings readily. This is a matter of some importance since starlings can not pass a hole $1\frac{1}{2}$ inches in diameter, which is sufficiently large for the entrance of bluebirds.

The following account is based mainly upon behaviors revealed by a pair of starlings which appropriated this observation box.

THE NEST

The starling is primarily a cavity-nesting bird. Old previously used nesting sites are preempted usually by the same pair of starlings throughout the season. Even throughout the wintertime the parent birds hold their respective boxes and, when not engaged in hunting food, spend the hours from dawn till dark fighting off meddlesome intruders of their kind, all the while indulging in their usual native loquacity and varied mimicry.

In February and March, or even in January, the starlings renew their nesting activities with an attendant increase in the power and variety of their vocal mimicry and expressions. They begin a very active inspection of the boxes and carry out and discard much of the old nesting material.

The new, clean observation box erected for them was quickly appropriated, and nest building began in March. Material, including mostly straw and grass stems, together with a few feathers, was very leisurely carried in by both sexes.

From the outset, the site of the nest depression itself was indicated

[1] Received October 26, 1939.

by a circular space bare to the bottom of the box, which elsewhere was covered about an inch deep with a mat mostly of dead grass stems and leaves. The circular space remained bare, neatly and carefully surrounded by the nest foundation, which was built up around it. As this mat became deeper, the depression itself finally received a layer of fine grasses and some feathers, to constitute the final nest hollow destined for the reception of the eggs.

From time to time both birds added an occasional straw or feather to the nest even long after the young had appeared. Occasionally a green leaf was brought in, a behavior that is indulged in by a number of birds, more especially by the larger birds of prey, but the purpose of this green material is not well understood.

Throughout all the procedure of nest-building the male worked as diligently and as devotedly as the female, for the starling's home activities involve an unfailing cooperation between the sexes at all times.

INCUBATION AND BROODING

Five eggs were laid, but the exact dates of laying were not determined. Following laying the male was quite as punctilious and faithful in the incubation of the eggs as the female.

The carrying of food to the brooding parent by its mate was never observed at any time. This would seem quite unnecessary since both parents share equally in the work of incubation and brooding. When one leaves the nest the other is usually entering and at once takes its place.

Frequently one or the other parent has arrived at the box entrance and expressed its desire to enter with food. The bird within, however, maintains its claim to the nest and not even its mate can enter until it has left.

On April 21 four of the five eggs had hatched, one delaying hatching until April 22, and this belated bird was destined by these fateful circumstances to become the runt of the family.

While the fledglings were very young and helpless the mother starling, alone, brooded them at night. The male was never seen to do this, although during the day he was quite as solicitous of the family and did his full share of brooding at every opportunity. While the birds were very tiny and naked and temperatures were low, the brooding impulse was much more persistently shown. Later, as the young birds became larger and covered with feathers, they were left at night.

When brooding took place, the parent bird settled down over the

young, always with the same characteristic procedure. This is done with a gentle sidewise wiggle into the final rest position. It would appear that this allows a better adjustment of the little birds to the parent's body, and is practiced by both male and the female.

FEEDING THE YOUNG

As previously stated, four eggs were hatched on April 21, and one on April 22. The young remained in the nest just 21 days. During this period development was rapid, from tiny, naked, blind, tottering mites of life to practically fully grown and feathered adults. This necessitated continuously changing adjustments on the part of the parents in supplying food to the young, in the sanitation of the nest, in brooding, etc.

Feeding began at once, both birds bringing in tiny caterpillars and other insects usually one at a time. These were usually crushed or macerated and very deftly and always very gently tucked into the tiny gaping throats. It was obvious that the parents seemed to realize that the tiny nestlings were in a helpless stage and required very dainty and gentle handling.

As the birds increased in size, there was a noticeable increase not only in the size of the caterpillars and spiders brought to them, but these were gathered by beakfuls, not singly as before. This change in the manner of feeding came about rather suddenly after the young birds were 6–7 days old. There was also a marked change in the manner of feeding, the very gentle profferings of the first few days giving place to more hurried and less solicitous jabs down the throats of the growing birds. There was of necessity a very evident speeding up of the entire round of family attention, involving more frequent visits with food, larger beakfuls, larger insect material, until finally, when the birds were half grown, hard-shelled June beetles, mulberries, and other bulky material were fed in a very impetuous manner.

Even after the young birds are fully grown and have left the nest, the starling families do not appear to disintegrate for some time. Although the young birds are well able to glean their own food, they may frequently be seen following the hard-worked parents around beseeching food. At such times it is not unusual to see the parents feeding them in the trees or on the lawns.

NEST SANITATION

It is obvious that where there are helpless young birds some degree of sanitation must be practiced so long as they remain in the nest.

This apparently becomes one of the great problems of the starling in the restricted room of their boxes and cavities. However, they make every effort to keep their young in a cleanly condition, and as the young themselves become older, they, too, become imbued with a sanitation impulse, which expresses itself in movements to or beyond the rim of the nest to deposit their excrement. The extent to which nest sanitation succeeds depends upon many factors, such as the industry of the parents, their mutual cooperation, the size of the nest box, the character of the food, the season of the year, temperature, etc. In very small crowded quarters, nest sanitation becomes much more difficult than in an airy, roomy box such as the writer's observation box.

Fecal deposition began as soon as feeding took place, and as the alimentary canal became filled the act almost regularly followed the feeding reaction. Both parents carried the fecal matter away, searching very circumspectly among the young for such material, picking up even the smallest particles. On a very few occasions this excrement was eaten, but this seems to be a very unusual behavior on the part of the starlings. The parents seemed to be quickly aware of fecal deposition and even appeared to watch a suspicious bird in the expectancy of this act, oftentimes, after each feeding.

Throughout the entire day, food was brought in usually with every visit, and excrement carried out on leaving. Only rarely did a parent bird enter without food or leave without fecal material. It was interesting to observe that when a parent bird brooded, it was instantly aware of the deposition of feces beneath it, probably from the feel of this extrusion upon its feet at times, and straightway it looked beneath and bore it away, to return quickly with food.

The starlings are early risers, and when the female had remained in the box at night to brood the very young birds, she left them at very early dawn even before it was light enough for her to seek food. However, during this pre-feeding period she busied herself industriously by carrying out fecal matter that had been deposited during darkness. Likewise in the evening, when the dusk had put an end to feeding operations, both birds continued to carry out fecal material so long as they could see.

At first the young were too weak and helpless to do more than defecate in the nest. Within four or five days from hatching, however, they began to evince a tendency toward nest sanitation of their own initiative. The young birds were making efforts to reach the side of the nest and scrambled over one another to take this position. After

the sixth day many depositions took place at the very edge of the nest, and very soon these were placed beyond and well away from the nest rim. This tendency finally became an impelling mood, and near the beginning of the third week of their existence the young had established a defecating zone far beyond the nest and toward the opening of the box. This is shown in Fig. 1. The actual factors that

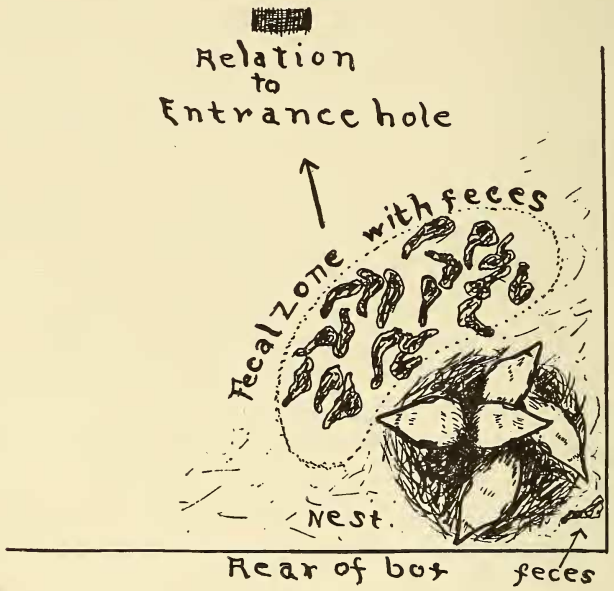

Fig. 1.—Sketch showing the deposition of the feces in a well-marked fecal zone outside the starling's nest at the beginning of the second week of existence by the young nestlings. It is evident that attention to personal cleanliness and nest sanitation has arisen in the behavior of the young birds in the course of their rapid development. With the strength and control of the muscular system has come a conscious or subconscious psychic manifestation of sanitation, working most admirably in the direction of comfort and economy of the family association.

determined the location of this zone are not known, but there is strong reason to believe that orientation was associated with the entrance hole and was dependent upon light or temperature conditions or both. Whatever the correct explanation, it is obvious that the young themselves, as soon as they were able, were governed by a sanitation impulse, and the adoption of this fecal zone greatly simplified the labors of the parents and resulted in better nest sanitation.

MAKING THE BED

From the time the young appeared, and until they had become almost independent of the nest, the parent birds concerned them-

selves very much with the making up of the nest, as it seemed. This operation was performed with equal attentiveness by both parents. The parent stood astride the nestlings or among them and jabbed its beak everywhere deep down beneath their frail little bodies, evidently poking holes into the consolidated mat, perhaps to aerate it or to hasten drying. Whatever this procedure meant to them it was done very frequently and thoroughly and with such vim that one wondered how the tiny nestlings escaped being injured at times.

This shaking up of the bed was also performed by the brooding mother during the night, when she remained with the young for the first few days after they had appeared. Oftentimes at dawn when she finally left the box to feed or to seek food for the young, it was evident that the nest had been entirely remade during the night. This was shown by an obvious deepening of the nest bed and a bringing in of new and clean straw material and feathers from the mat within reach.

As one or the other of the parents has taken its position over the young birds to brood them, it has more than once been seen to reach out and seize a straw and poke it beneath its body. At other times it has picked up a loose feather and dropped it over its body so that it fell loosely over the head or body. Such material probably sooner or later falls into the nest and constitutes a new and clean lining.

REACTIONS TO EXTRANEOUS MATERIAL INTRODUCED INTO THE BOX

During the writer's study of the starlings' family life, various experiments were carried out. When the parents had gone, a great variety of material was dropped into the box, including pieces of flowers, green leaves, green shoots, bits of banana, fragments of paper, chewed wads of paper, wood shavings, prune seeds, and such animal material as May beetles, snails in the shell, cutworms, chrysalids, and angleworms, all of which had been immobilized by crushing to prevent their escape. Likewise small strawberries were dropped into the box. Much of this constituted the normal material fed to half-grown birds.

The green leaves were scrutinized critically but were usually allowed to remain, together with such material as small pieces of paper and dry wood shavings. All other material, of whatever nature, including May beetles, strawberries, etc., even though constituting the natural food when brought in by the parents, was unhesitatingly discarded. Such material as paper, bits of leaf material, etc., that

could be incorporated into the nest appeared to pass as nest material and was allowed to remain. Food substances of whatever nature, however, appeared to fall into the category of waste material comparable to fecal matter and were usually very promptly discarded.

Strangely enough, if the parent bird dropped an insect morsel while attempting to feed a young bird, it invariably picked this up and offered it again. On the contrary, insect material found in the box or nest was never directly fed. In one instance a roach dropped into the box was quickly carried out by the returning male, and when he reappeared he offered a ground roach to the young. Whether this was the same roach previously dropped into the box can not be established, as these insects were sometimes brought to the young.

The placental structure of a large green pepper with the seed attached was dropped into the box in the absence of the parents. This object was nearly as large as the entire dimensional size of the young. It was casually inspected by the first bird to enter the box but was untouched. However, when accidentally knocked into the nest by one of the parents returning later with food, it was finally carried out of the box, but not without some effort owing to its weight and bulkiness.

SOCIAL RELATIONSHIPS

The starlings at all times are more or less gregarious in their relations. Even when the family burdens of the summertime break up their great winter aggregations, they remain friendly to one another and never entirely lose the helpful social spirit. Unlike many other more individualistic and independent birds, they appear to evince no definite territorial claims and forage and feed wherever they choose, oftentimes together.

The starling is very largely a ground feeder. As it scrutinizes the grass and ground debris it has a very characteristic habit, peculiar also to the grackle and perhaps to various other blackbirds. As it thrusts its beak into the grass and ground debris, it spreads the mandibles apart with every thrust, either to enlarge the hole its beak has made or perhaps to feel with its tongue. Whatever the purpose of this behavior it is an invariable racial trait. The starling never scratches in the ground debris as do the chewink and many sparrows and never tosses the loose debris about with its beak as does the brown thrasher.

Although the starling is preeminently a ground feeder, preferring lawns and open fields for its foraging, it is inordinately fond of mul-

berries and very readily distinguishes the ripe black fruits from the red green ones. To this degree its color sense is highly developed.

In the wintertime when the gregarious mood has reached its height, the flocking impulse is a marked feature of all its behaviors. It flies from its city rendezvous to the country to feed by day, and returns in the evening, often aggregated into enormous flocks, whose precise and synchronized maneuverings are marvelous to behold.

In the wintertime the starlings are wont to feed in similar formations, which move very systematically over a field as the birds walk along. However, with their keen insight those in the rear of the formation realize that the new territory just ahead of the advancing front line is likely to afford the choicest morsels. These then constantly arise and fly ahead and descend to become in their turn briefly the front line, for they too, will soon be replaced by others flying up from the rear. Thus the foraging flock moves along smoothly, partly by walking and partly by flight, enabling all the members to have their chance in the scrutiny of new ground, which otherwise would be denied those always remaining in the rear.

The starlings cling very tenaciously to the boxes and nesting sites they have preempted and will fight almost to the death any interlopers of their own kind, or even other birds. The writer once found a pair of females locked so tightly together by beak and claw, as the result of a combat, that both birds lay helpless in the box, and when picked up could only be disengaged with much effort. How long they had lain thus is not known.

In the writer's trees the flickers fought bravely to oust starlings from their boxes, but they were no match for their smaller and more agile adversaries. On several occasions a flicker struck at a starling with great force, but his blows were too slow and deliberate to reach his more active enemy. On several occasions the starlings showed tendencies to gang up against the larger bird and were frequently seen to cling tenaciously to their feathers in their attacks.

The story was entirely different with the little screech owls that nested next door to the starlings. The latter never ventured into the owls' quarters, although on several occasions the little owls at dusk were seen peeping into the starlings' homes. In spite of their hatred of the owls, both birds carried on their economies in close proximity, but it was plainly obvious that the starlings merely accepted the inevitable quietly, since there was nothing else to do.

Occasionally a small hawk appeared; then the starlings became

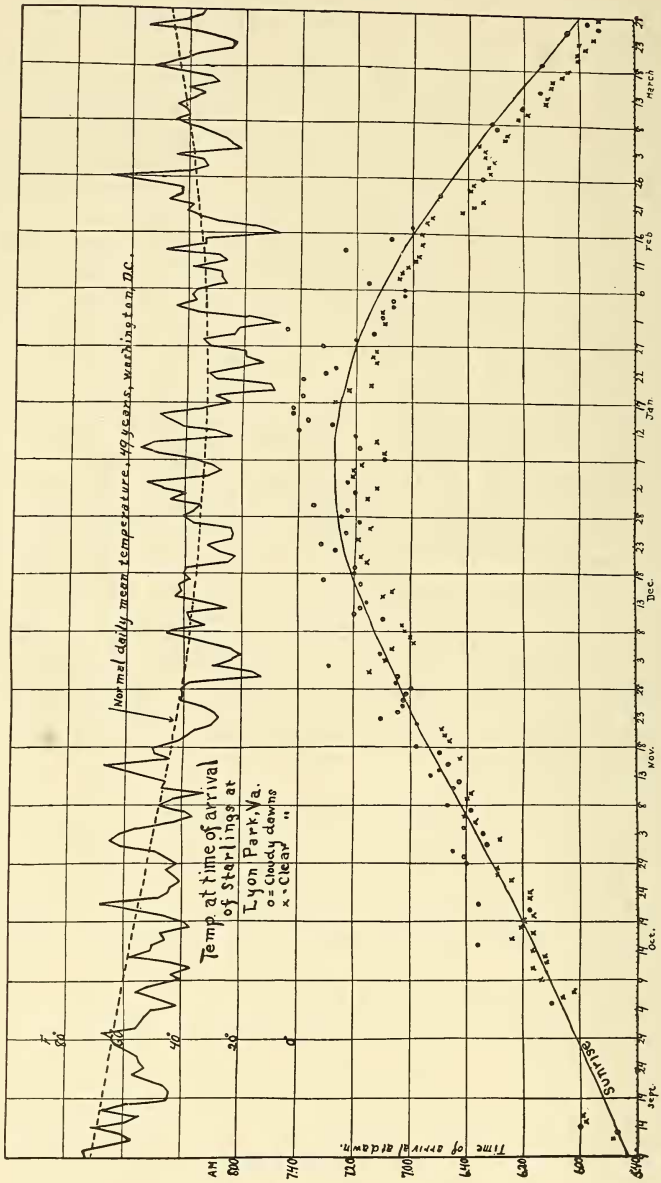

Fig. 2.—Time of dawn arrival of the starlings at Lyon Park, Va. 1929–30, in relation to the sunrise curve (E.S.T.) and temperature at time of arrival. Broken line shows the normal daily mean temperature at Washington, D. C., for 49 years.

alert and even gathered into bands and flew about ready to persecute it with their disconcerting maneuverings.

During the summer when the female remained with the tiny young at night, the males appeared to roost nearby in pine trees. Later when neither parent remained with the young birds, the males and females appeared to repair to their respective roosts somewhere near at hand. In autumn, when the flocking urge is at its height, both parents, apparently still mates throughout the winter season, fly to and from the city where they spend their nights.

The time of leaving the nesting box at night and of the arrival at dawn depends upon the factor of light intensity, and these curves follow closely the curves for the seasonal time of sunrise and sunset (Figs. 2–4). During the winter season, however, those light intensities that send the birds to roost are far higher than those that drive them to roost in summertime, as if they were very loath to leave their young. It is highly probable here, however, that we have marked seasonal differences in physiological sensitivity of the eye to light, owing to the very different hormonal organization expressing itself at the two seasons.

DISCUSSION

We have followed some of the more striking behaviors of a family of starlings from the time of nest building to the maturity of the young birds and the final abandonment of the nest by these exactly 21–22 days from the hatching of the eggs. It is evident that there are many outstanding behaviors in the starlings' life history concerned with nesting, incubation, feeding, and sanitation that are of much interest.

In the first place, a remarkably close cooperation between the male and the female obtains in all the essential activities connected with the preparation for and the raising of the family.

The male aids in nest building, incubates the eggs, feeds the young, and attends to the cleanliness of the nest with as much interest and punctiliousness as does the female. There appears to be one phase of duty, however, that he does not normally assume. The female, alone, appears to remain with the tiny, helpless young for the first few nights of their existence.

The writer has heard it stated that starlings are filthy birds, but this can not apply indiscriminately to all starling parents. It is probably nearer the truth to say that starlings do their best to maintain clean nests for their families.

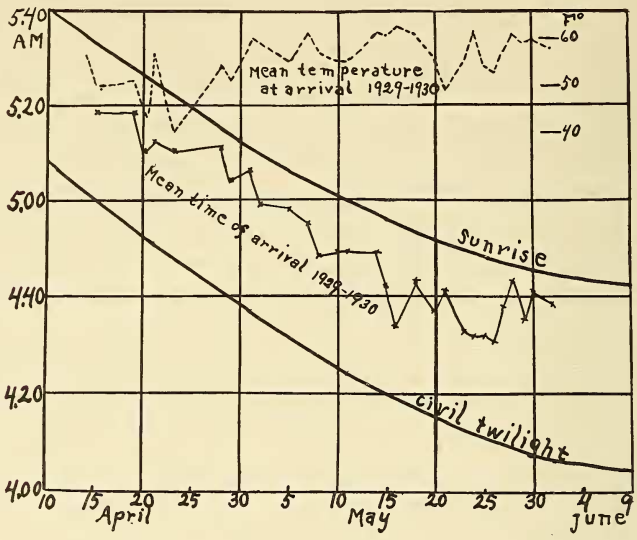

Fig. 3.—Mean time of arrival of the starlings at Lyon Park, Va., derived from the data of 1929 and 1930. The two-year temperature mean at the time of arrival is also shown. The correlation between sunrise and the two-year mean for the first arrival for the years 1929–30 as obtained was 0.962 ± 0.009. The correlation between the two-year mean of first arrival and the two-year temperature mean was found to be -0.482 ± 10.

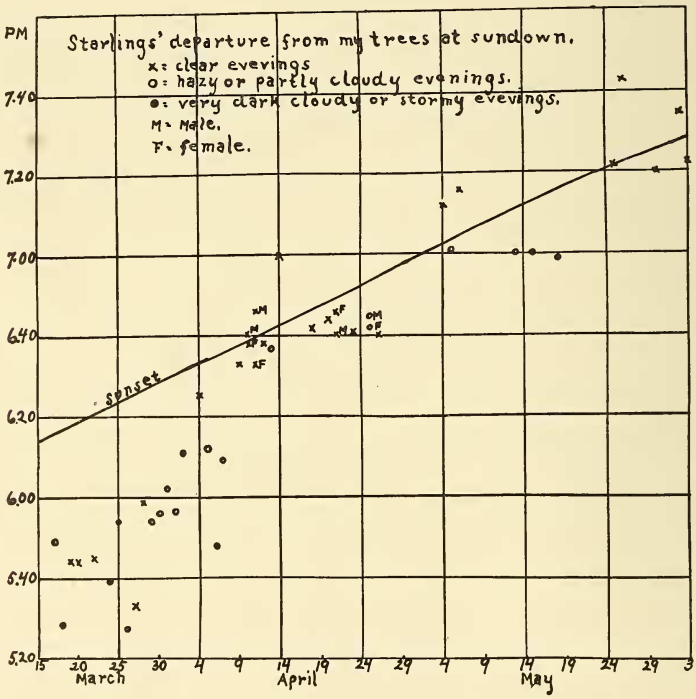

Fig. 4.—Departure of the starlings from trees of the writer at Lyon Park, Va., at sundown, 1930, in relation to sunset (E.S.T.).

Should one or the other parent die, there is every reason to believe that the remaining parent would assume the care of the family to the best of its abilities. In such an event it is probable that the usual degree of cleanliness of the nest could not be so successfully maintained as when two conscientious mates were working industriously toward the same end.

Nest sanitation is a real necessity for the health and comfort of the young birds, and many factors must modify the degree of success attained, one of no small importance being the roominess of the cavity holding the nest.

It is obvious that the young themselves very soon evince tendencies toward cleanly habits, which has finally expressed itself in the adoption of a definite fecal zone entirely without the nest. We have, here, the foreshadowing of the localized or latrine concept, which some animals have evolved to a high degree.

Where sanitary conditions have not been maintained, for one reason or another, conditions may become so filthy as to cause the death of the young birds. In one instance a young bird that had left its nest nearby was scarcely able to use its legs from the enormous thickness of the excrement dried and accumulated upon them. It required much effort and washing to free this bird of its filth, and it would probably have died had it remained in its befouled condition. It is not known what causes were responsible for this.

It has not been determined whether unattached birds—one may call them widows, spinsters, or bachelors—ever enter into the care of a starling family, where one or both parents die. It seems probable that this may occur, however, for on several occasions when the legimitate parents of the family under observation were away, strange starlings have occasionally appeared at the box entrance to peep in curiously. These are quickly driven away when the parents arrive.

One of the most striking features of starling behavior is the rigid observance of carrying out all introduced material, food or otherwise, that has been dropped into the box. It would appear that all extraneous matter not brought in by the parents themselves, even though it may be acceptable food, is treated as if it belonged in the category of excrementitious material.

Some biologists would explain all the niceties of adjustment and accomplishment we have observed as an example of a train of mechanized integrated behaviors from which there was no escape. The writer feels that we can not talk too dogmatically on this point. At times there seems to be some element of experienced judgment in

operation as much as anything else. It is obvious that rarely has there been any useless, accidental behavior shown, all behaviors operating smoothly, rapidly and progressively to meet in a timely manner, all the needs and adjustments demanded by a rapidly changing developmental cycle.

The writer does not feel qualified at the present time to say what moods in these behaviors are consciously reasoned and what are purely mechanical, to be dogmatically referred to reflexes, tropisms, or whatnot. Even we, in our highly civilized moods, at times show many instances of mechanized, stereotyped behaviors that have no longer logical meaning for the situation, as when we cling to archaic procedures simply because they are sanctioned by custom or habit or had become legal usage long ago.

A study of the starlings' behavior and family life indicates a very high order of bird intelligence throughout and a close attention to all phases of the family welfare. It is evident that the intimate understanding and cooperation of the two parents in all the stages of preparation for and the care of the family have helped to make the starlings highly adaptive and successful birds wherever conditions are favorable for their survival.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE ACADEMY

COMMITTEE ON CATALOGING SCIENTIFIC SOCIETIES OF WASHINGTON AND DEFINING QUALIFICATIONS FOR AFFILIATION

As its meeting on November 10, 1939, the Board of Managers received and accepted a report from a committee, consisting of C. P. Clausen, F. M. Defandorf, W. D. Lambert, J. E. McMurtrey, Jr., and W. T. Schaller (chairman), dealing with the cataloging of the scientific societies of Washington and the definition of the qualifications of a society for affiliation with the Academy.

To be eligible for affiliation the given scientific society, association, or club must be concerned with natural science, with the social, economic, or historical sciences, or with any phase of engineering; must hold its meetings within an area that includes the District of Columbia and the territory lying within 25 miles of it; must have a membership of whom the majority reside within the area indicated; must have a regularly constituted organization with elected officers; must concern itself primarily with the search for facts and truths rather than with the popularization or commercial exploitation of them; and must have at least an effective nucleus of members actively engaged in pure or applied scientific research who control the policies of the society.

The list of scientific societies, associations, and clubs reported by the present committee, which completed work begun by an earlier committee of the